Any policymaker trying to alleviate India's poverty cannot neglect the fact that the World Development Report 2008 clearly says that 'GDP growth originating in agriculture is at least twice as effective in reducing poverty as GDP growth originating outside agriculture'.

The power of agriculture in reducing poverty is observable in the Chinese case, especially during 1978-84, the initial years of reform. China began its reform process with agriculture: by moving from the commune-based system to the household responsibility system, and by revising agricultural prices upwards by more than 20 per cent. The results were spectacular. The agricultural growth rate jumped to 7.1 per cent per annum during 1978-1984, up from 2.5 per cent during the pre-reform period of 1966-1977. This was followed by a dramatic reduction of poverty: from 33 per cent to 15 per cent in the early reform period between 1978 and 1984 (Gulati and Fan 2008: 6). Much of this can be ascribed to the bottom-up approach of reforms adopted by China—that is, starting from the agricultural sector. This is unlike India, which chose a top-down approach—that is, initiating reforms in the non-agricultural sector. As a result, the process of poverty reduction has been held hostage to the 'trickle down' effect.

With more than 52 per cent of the workforce still dependent on agriculture for their livelihood, agriculture in India has a far-reaching impact on poverty reduction as well as on rural development. Agriculture forms the resource base for a number of agro-based industries. Thus, it would be more meaningful to view agriculture not as farming alone but as a holistic value chain, which includes farming, wholesaling, warehousing (including logistics), processing, and retailing. Also, the fact that an average Indian spends more than 50 per cent of his monthly expenditure on food establishes the centrality of agriculture in the context of food security concerns (GoI 2006a). These factors together determine the critical importance of agriculture in general, and food in particular. Also, for the economy to grow at 9 per cent, it is important that agriculture should grow at 4 per cent.

Productivity in Indian Agriculture

Low Levels of Productivity

Productivity is generally considered from two angles—(i) productivity of land, and (ii) productivity of labour engaged in agriculture. There has been a slow and steady rise in productivity during 1950-51 to 1997-98 for most of the crops. GDP per hectare was Rs. 875 in 1950-51 which rose to Rs.1023 in 1960-61, Rs.1204 in 1970-

1971 and further to Rs.1401 in 1979-80 (figures are at 1970-71 prices). Thus, output per hectare rose by 60 per cent over the period 1950-51 to 1979-80. However, productivity per worker has remained almost stagnant over the period as would be clear from the fact that GDP per worker which was Rs.1019 in 1950-51 fell to Rs. 988 in 1960-61, rose to Rs.1013 in 1970-71 and to Rs.1025 in 1979-80 (figures are at 1970-71 prices).[3]

A comparison of productivity levels in Indian agriculture with the levels in other countries shows how low the productivity in Indian agriculture is. Productivity of wheat in India is about 35 per cent of the productivity in France. It is 66 per cent (i.e., less than two-thirds) of the productivity in comparison to another underdeveloped country, China. As far as rice is concerned, productivity in India is 46 per cent of the productivity in China and Japan (i.e., less than half). The productivity of cotton in India is one-third of the productivity in China. Even in comparison to Pakistan, productivity of cotton in India is just 61 per cent. As far as groundnut is concerned, productivity in India is 34 per cent of the productivity in USA, 40 per cent of the productivity in China and 51 per cent of the productivity in Argentina. Similar conclusions hold for most of the other crops.[4] The low levels of productivity in Indian agriculture point to the possibilities of increasing productivity by adopting appropriate strategies and policies.

International comparisons reveal a wide gulf in India's performance between achievements in output and productivity. While India compares favourably in terms of total output, it compares poorly in terms of yield per hectare. For example, India has 60 million hectares of land under irrigation compared with just 47 million in China, but its food grain production is barely 40 per cent of China's cutput. Broadly, Table 11.2 shows India's relative world ranking in production and yields of a range of aricultural commodities.

Causes of Low Productivity

The causes of low productivity can be divided into the following three categories: (i) general, (ii) institutional, and (iii) technical.

General Causes

Pressure of Population on Land: With increasing pressure of population on land, per capita cultivated land has declined from 0.444

3. Rao, J. Mohan (1994). "Agricultural Development under State Planning", in Terrence J. Byers (ed.), *Development Planning in India*, Table 3, p. 260. New Delhi: Oxford University Press.
4. Tata Services Ltd., *Statistical Outline of India*, 1998-99.

hectares in 1921 to 0.296 hectares in 1961 and further to 0.219 hectares in 1991. Increasing pressure of population on land is partly responsible for the sub-division and fragmentation of holdings resulting in low productivity.

Institutional Causes

Land Tenure System: A very important reason of low agricultural productivity has been the exploitative land tenure system in the form of *zamindari* system. Highly exploitative in character, this system drained out the very capacity, willingness and enthusiasm of the cultivators to increase production and productivity. Legislations passed for abolition of intermediaries in the post-Independence period did not break the stranglehold of the *zamindars* on the rural economy. They only changed their garb and became large landowners. Exploitative practices continued. Regulation of rent, security of tenure, ownership rights of tenants, etc., did not make the position of tenants better. Tenancy of most of the tenants continues to be insecure and they have to pay exorbitant rates of rent.

Uneconomic Holdings: According to the National Sample Survey, 52 per cent holdings in 1961-62 had a size of less than 2 hectares. In 1990-1991, 78 per cent of total holdings fell under this category. Most of these holdings are not only extremely small, they are also fragmented into a number of tiny plots so that cultivation on them can be carried out only by labour-intensive techniques. This results in low productivity. Until the excessive labour employed in agriculture is transferred to alternative jobs and the holdings are consolidated (or cooperative farming initiated), modern techniques of agriculture cannot be adopted and the possibilities of increasing agricultural productivity will remain limited.

Technological Factors

Outmoded Agricultural Techniques: Most of the Indian farmers continue to use outmoded agricultural techniques. Wooden ploughs and bullocks are still used by a majority of farmers. Use of fertilisers and new high-yielding varieties of seeds is extremely limited. In brief, Indian agriculture is traditional and therefore, productivity is low.

Irrigation plays an important role in Indian agriculture. Currently, nearly 45 per cent of the 175 million ha of the country's cropped area is irrigated.

Irrigated area has nearly trebled since the early 1950s—from around 24 million ha in 1953-54 to nearly 75 million ha in 1998-99. According

to one recent estimate, nearly three-fourths of the increment in total crop output between the early 1970s and early 1990s came from expansion of irrigated area and increase in per hectare yields on irrigated land. Unirrigated crop areas have actually declined and the rate of yield improvement on these areas has been far slower overall, compared to irrigated areas (Vaidyanathan, 2007).[5]

This shows that even now about 55 per cent of the gross cropped area continues to depend on rains. Rainfall is often insufficient, uncertain and irregular. Accordingly, productivity is bound to be low in all those areas which lack irrigation facilities, and are totally dependent on rains. Even in areas having irrigation facilities, potential is not wholly utilised because of defective management. The costs of irrigation are also increasing continuously and the small farmer is, therefore, unable to make use of available irrigation facilities.[6]

12

Agricultural Growth, Performance and Policies

The Institutional Context

IT is important, at the very outset, to understand the institutional, demographic and socio-political context within which agricultural growth has been taking place. The prevailing framework had a profound impact on the pattern of agricultural development. This, in turn, has necessitated special strategies and policies for employment generation and poverty removal in rural areas. The thrust of policies, in the first decade of planning (1951-1961) was on institutional and agrarian reforms. In an agrarian economy like India with great scarcity and unequal distribution of land, coupled with a large mass of below poverty line rural population, there are compelling economic and political arguments for land reform. Not surprisingly, it received top priority on the policy agenda at the time of Independence. In the decades following Independence, India passed a significant body of land reform legislation. The Constitution of 1949 left the adoption and implementation of land and tenancy reforms to state governments (Maitreesh Ghatak, 2007). The two basic objectives of land reforms were: (i) to remove such impediments on agricultural production as arise from the character of agrarian structure in rural areas, and (ii) to reduce or eliminate exploitation of landless and small cultivators through measures of land redistribution.

Land reform legislation in India consisted of four main categories: abolition of intermediaries who were rent collectors under the pre-Independence land revenue system; tenancy regulation that attempted to improve the contractual terms for tenants, including crop shares and security of tenure; a ceiling on landholdings with a view to redistributing

surplus land to the landless; and finally, attempts to consolidate disparate landholdings.

The New Technology

It was becoming clear by the mid-sixties that there was no alternative to technological change in agriculture for achieving self-sufficiency in food grains. Even those countries in Asia which could carry out radical land reforms and build up an adequate infrastructure for agriculture had taken to the path of modernising agriculture. Japan took the lead in this direction and China followed suit even after successfully experimenting with structural changes and mobilisation of a growing labour force for capital construction in agriculture.

Characteristics of New Technology

The distinguishing characteristic of the new technology lies in the substitution of traditional robust but low-yielding varieties of seed by the so-called high-yielding variety. These seeds have the physiological attribute of being able to turn large amounts of soil nutrients into grain rather than leaf growth. This enables the plant to produce higher yields, especially so if the supply of nutrients in the soil can be increased. This in turn creates the demand for chemical fertilisers to supplement the natural fertility of the soil. Because these contain nutrients in concentrated form, they have to be applied with adequate supplies of water to enable the plant to absorb them without damaging itself. A lack of adequate water supply not only reduces the yield but may do so substantially.

Better Agricultural Practices

This seed-fertiliser-water package in turn calls for better agricultural practices for the effective utilisation of the technology.

First, the plant requires the fertiliser-water input at particular stages of growth to give the best yields.

Secondly, as fertilisers can be absorbed by weeds as well as by the plant, effective weeding is required to prevent waste of expensive fertiliser.

Thirdly, while the HYV seeds give higher yields, they are more prone to damage from excessive watering. For example, shorter-stemmed dwarf varieties are more liable to be flooded. They, thus, require more effective water control and better drainage. The need is for controlled and adequate water supplies.

Fourthly, being relatively new and non-acclimatised strains, they are more prone to local pests and diseases than established indigenous varieties and therefore, require a supply of germicides and pesticides.

Two further physiological characteristics of the new seeds are that they are quicker maturing than the traditional varieties and they are non-photosensitive. On the one hand, these two characteristics give rise to a shorter harvesting period, thus making it possible for farmers to practise multiple cropping, enabling them to use more intensively a given amount of land. Fertilisers, by enabling more production per acre to be achieved, and the quicker maturing HYV seeds, by making it possible to practice double cropping during the year, both act as land-saving innovations. Hence, their attraction to a land-hungry south Asia. On the other hand, as the crop may be ready for harvesting during the monsoon season at a time when the cloud-cover has not yet dispersed, a possibility of loss of output due to a lack of drying and storage facilities is also opened up.[1]

Thus, the basic technological characteristic of the new technology is the application of a number of inputs which are complementary to each other. The application of these joint inputs yields much larger volumes of output of food grains as a result, largely by increasing yield per acre. However, in order to assess the impact of the technology on Indian agriculture, we have to also take into account some of the economic characteristics of that technology. In an economy where labour is relatively plentiful, it has low opportunity cost. Most agricultural holdings in India use either family labour or fairly low-paid agricultural labour, neither of which, generally speaking, can command high levels of alternative earnings. For traditional agriculture, the most expensive input, other than land, is bullock-power. The new inputs are mostly of manufactured origin, such as fertilisers, pesticides or pumps, and are more expensive. In non-rainfed agriculture, there are also costs attached to irrigation, in the form either of the capital costs of sinking a well or installing a pump or running costs in the form of purchase of diesel fuel or payment of water rates.

Economic Aspects of New Technology

The new practices, therefore, are much more expensive to the farmer. This has three implications. First, the extent to which the various inputs are applied in practice depends not on some technologically

1. Choudhary, Pramit (1978). *The Indian Economy: Poverty and Development*, ch.5, pp.121-123. New Delhi: Vikas.

efficient dosage but on an economically optimum one. This depends in turn on the relative prices of inputs and outputs facing the producer. Minhas and Srinivasan have shown that fertiliser application is subject to diminishing returns, the economically optimum dose being smaller than the technical optimum. As technologically some of the inputs are complementary, the extent to which the application of a particular input can be profitably pushed depends also on the availability of, and the ability to purchase, other inputs. For example, the degree of fertiliser application that is profitable will depend on the availability of water and on the ability of a farmer to purchase the use of both inputs.

Secondly, the new technology is only worthwhile in terms of private benefits, e.g., if the farmer receives yields which are not only larger than traditional varieties but are substantially so, to make up for the additional variable costs of cultivation. This in turn requires, thirdly, a more intensive use of the fixed factor, e.g., land. The new technology opens up the possibility of multiple cropping; the economic imperative drives the farmer to it. This is compounded by the fact that while the new technology yields larger outputs, it is also more subject to risks. We have noted that the HYV seeds are prone to damage from flooding, water scarcity and pests. Moreover, because the farmer is a newcomer to these practices, he is also ignorant of how to respond if something goes wrong. Additionally, where he is involved in substantial cash outlays in order to utilise the new technology, he bears a liquidity risk. This is reinforced by the fact that very often, the farmer may have to resort to borrowing in order to meet the additional costs of cultivation. A crop failure saddles him with the burden of debt.

These economic aspects of the new technology are as important as its technological characteristics to our understanding of the impact of the 'green revolution' upon the agrarian economy, especially in relation to the problems of mechanisation and of unequal incidence of acceptance and use between large and small farmers. That impact can best be studied in terms of the effects of the new technology on output, employment and the regional and interpersonal distribution of gain arising from the adoption of that technology.

Three Phases of Green Revolution

Gulati and Fan (2008)[2] identify three phases of the green revolution.

2. Gulati, A. and Shenggen Fan (ed.) (2008). *The Dragon and the Elephant—Agricultural and Rural Reforms in China and India*, ch.2. New Delhi: Oxford University Press.

The First Phase, 1966-1972

To end its dependence on P.L. 480, India, prompted by the minister of agriculture at that time, C. Subramaniam adopted a new agricultural strategy to boost grain production accompanied by remunerative support price for farmers. In January 1965, the Agricultural Prices Commission was set up to recommend a MSP, followed by the Food Corporation of India (FCI) to take charge of the logistics of procuring major agricultural commodities (Gulati, 2003). In the same year, India took a bold step by allowing the introduction of new high-yielding seed varieties (HYV) of wheat from Mexico. In 1966, India ordered the import of 18,000 tonnes of HYV wheat seeds that were distributed in the highly irrigated areas of Punjab, Haryana and western Uttar Pradesh where the past investments in irrigation had paid rich dividends.

The new seeds could yield more than double the existing levels and thus had the potential to dramatically increase wheat production and food grain supply. Under the new agricultural policy, the spread of HYVs was supported by public investments in fertilisers, power, irrigation and credit.

The total amount of food grains harvested increased from 74 mt in 1966-67 to 105 mt in 1971-72, and that year India became self sufficient, with grain imports declining to nearly zero.

These outcomes would not have been possible without the favourable pricing policy that provided farmers with adequate incentives, the dynamism of the national research system that proceeded to indigenise the new seeds to tackle their shortcomings (Gulati, 2003), and the availability of inputs including canal water, fertilisers, power and credit. In view of the strategic importance of these critical inputs, it was the responsibility of the government to ensure that farmers had affordable access to them. Subsidies thus, became an instrument of agricultural policy in the late 1960s and acquired greater importance in the 1970s (Gulati and Narayanan, 2002a). The role of credit began to be important after 1969 following the nationalisation of banks.

Improved agricultural production resulting from modern input and technologies "trickled down" to the poor and led to a rise in farmer income, while output growth and increased grain supplies caused a decline in real food grain prices, benefiting the poor. Thus, rural poverty declined significantly in this phase, from 64 per cent in 1967 to 56 per cent in 1973 (Datanet India Pvt. Ltd., 2006). Several government anti-poverty programmes were also introduced during the Fourth Five-Year Plan in the early 1970s. (Gulati and Fan, 2008)

Debacle and the Second Phase, 1973-1980

After the nationalisation of the banks, Prime Minister Indira Gandhi took other steps to extend the role of the state in key areas of economic management. In agriculture, private wholesale traders came under attack because, due to their speculative motives, they were regarded as responsible for fluctuations in food grain prices and supplies. Thus, in 1973-74 the government took over the wholesale trade in wheat, which proved a disaster (Chopra, 1981) and therefore, it was soon abandened. Wheat procurement was hindered by limited supply resulting from droughts in several states in 1972-73.

Following two consecutive droughts in 1972-73, food grain production decreased by 7.7 per cent (India, Ministry of Agriculture, 2003), and India slid back into the trap of food grain imports of an average of about 4 mt a year from the United States between 1973 and 1976.

After the oil shock, the government increased fertiliser subsidies to prevent a drop in consumption following the rise in fertiliser prices. In 1977, the retention price scheme was introduced for urea, the predominant fertiliser in Indian agriculture. During the 1970s, other input subsidies grew in importance within the state budget (Fan, Thorat and Rao, 2004), and the subsidy bill excluding fertilisers grew from Rs. 10 billion at constant prices to Rs. 33.2 billion, or from 0.5 per cent to 4.0 per cent of agricultural GDP between 1973 and 1980 (Gulati and Narayanan, 2002a).

Also during this period, groundwater irrigation increased in importance, with its share rising from 0.55 per cent to 19.5 per cent between 1960 and 1975 (Datanet India Pvt. Ltd., 2006) on account of private investment in tubewells by farmers who reinvested the income from the earlier burst in foodgrain production. As a result, power subsidies for water pumping grew dramatically, reaching 44 per cent of the total input subsidy at the start of the 1980s (Gulati and Narayanan, 2002a).

The extension of HYV technology from wheat to rice, favoured by the growth of tubewells, spread the green revolution to new areas, marking a new phase in the expansion of domestic production. From 1972-73 to 1979-80, production as well as yields of food grains showed remarkable growth, at 3.1 per cent and 2.5 per cent, respectively, and rural poverty declined from roughly 56 per cent to 50 per cent (India, Ministry of Agriculture, 2004).

The Third Phase, 1981-1990

In the 1980s, India consolidated its status as a food self-sufficient country. Rice production soared to 63.8 mt in 1986, up from 37.0 mt in 1964. Wheat output grew, too, from 12 to 47 mt in 1986, a year in which India had her first 25.4 mt of grain buffer stocks (India, Ministry of Agriculture, 2004). When in 1987 the "worst drought of the century" struck the country, food needs could be easily met without any loss of lives (Gulati, 2003).

During this phase, the HYV technology spread eastward to states like West Bengal and Bihar, which experienced surpluses in rice, with output over the 1980s growing at 5.0 and 3.7 per cent, respectively (Datanet India Pvt. Ltd., 2006). However, in the rest of the country the green revolution ran out of steam by 1985 once the new seed varieties had been widely adopted in the main producing regions. Yields for rice and wheat that had grown, respectively, by 3.5 per cent and 4.5 per cent per annum between 1967-68 and 1984-85 slowed down to 2.3 and 2.4 per cent per year between 1985-86 and 1999-2000 (IFPRI, 2004). With the HYV technology exhausting its impact in the mid-1980s, input subsidies were steadily increased to continue sustaining food grain production growth. By 1991, input subsidies had grown to 7.2 per cent of agricultural GDP as compared to 4.4 per cent in 1980 and 2.0 per cent of total GDP from 1.5 per cent in 1980 (Gulati and Narayanan, 2002a).

Throughout the green revolution, Indian agriculture laboured under a strictly regulated policy regime characterised by wide restrictions on production through licencing requirements and barriers to entry, as well as controls on pricing, movement and private trading of agricultural produce. On the external front, too, the sector was burdened with various tariff and non-tariff barriers to agricultural trade flows. (Gulati and Fan, 2008)

The high level of protection accorded to industry produced high industrial prices and adverse terms of trade (ToT) for agriculture, reducing the relative profitability of the primary sector. Agriculture was overall net taxed (disproteced) on account of the overvalued rupee, which produced an anti-export environment for agriculture. The objectives of this framework were broadly dictated by the dominant strategy of the pre-reform era, that is, food self-sufficiency resulting from domestic supplies, aiming to: (1) ensure inexpensive food for consumers, (2) protect farmers' incomes from price fluctuations, and (3) keep the balance of payments in check. (Gulati and Fan, 2008)

Reform Period, 1991 to the Present

Although the reforms were implemented in off-farm activities, they affected agriculture in at least two important ways (Landes and Gulati, 2003). First, the higher rate of economic growth and the consequent rise in per capita incomes resulting from the 1991-1993 reforms had a significant impact on food demand. Higher per capita incomes, growing at 4.5 per cent per annum in this phase as opposed to 3.6 per cent in the 1980s (WDI, 2004), led to the diversification of food demand into non-food grain crops such as fruits and vegetables, as well as meat—mainly poultry—and dairy products. Second, the lowering of industrial protection significantly improved the incentive framework for the sector through improvement in the domestic ToT between agricultural and industrial prices, which rose from 0.9 to 1.2 between 1991 and 2000. (Gulati and Fan, 2008)

Improved ToT for agriculture in turn resulted in an increase in the profitability of the primary sector relative to industry and led to an increase in private investments, which are now double the public investment in agriculture. These were increasingly directed to the production of horticultural produce, poultry, fish, milk and eggs in response to booming consumer demand for these high-value agricultural products, leading to a remarkable growth in output of these commodities during the 1990s relative to the previous decade.

As a result of these developments, agricultural GDP went up from 3 per cent in the 1980s to 4.1 per cent in the aftermath of reforms between 1991 and 1996.

Deceleration in Agriculture Growth

Growth of agricultural GDP decelerated from over 3.5 per cent per year during 1981-82 and 1996-97 to only around 2 per cent during 1997-1998 and 2004-05 (Table 12.1). This deceleration, although most marked in rainfed areas, occurred in almost all the states and covered almost all the major sub-sectors, including those such as horticulture, livestock and fisheries where growth was expected to be high.

States with high percentage of rainfed areas have suffered heavy decline in growth during the period 1995-96 to 2004-05. Also, the instability in output growth is more in states with high percentage of rainfed areas.

TABLE – 12.1

Average GDP Growth Rates—Overall and in Agriculture
(Per cent Per Year at 1999-2000 Prices)

Period	*Total Economy*	*Agriculture and Allied Sectors*	*Crops and Livestock*
1. Pre-green revolution 1951-52 to 1967-68	3.69	2.54	2.65
2. Green revolution period 1968-69 to 1980-81	3.52	2.44	2.72
3. Wider technology dissemination period 1981-82 to 1990-91	5.40	3.52	3.65
4. Early reforms period 1991-92 to 1996-97	5.69	3.66	3.68
5. Ninth Plan 1997-98 to 2001-02	5.52	2.50	2.49
6. Tenth Plan period 2002-03 to 2006-07	7.77	2.47	2.51
of which 2002-03 to 2004-05	6.60	0.89	0.89
2005-06 to 2006-07	9.51	4.84	4.96

Source: *Eleventh Five Year Plan 2007-2012*, Vol. III, 2008.

There had been a declining trend of acreage for most of the crops during the period 1995-96 to 2004-05, except that for wheat, the acreage of which registered a modest growth of 0.11 per cent per annum. In the decade prior to 1995-96, the area under oilseeds, cotton and sugarcane registered impressive growth but this trend also reversed in later decadal interval. Given the near stagnant net sown area of 140 million hectares and gross cropped area of about 190 million hectares, there was increase in area under certain crops at the expense of declining area under other crops. In the subsequent decade, the scope of increase in area vanished across the crop segments. This trend clearly indicated constraints in availability of land for agriculture due to competing pressure on land demand for non-agriculture sector and rapid urbanisation witnessed in the recent years.

There was sharp decline in the growth rate of productivity of all the crops in the decade of 1995-96 to 2004-05. The productivity growth of rice and wheat, the anchors of Green Revolution in the past, decelerated to 0.82 per cent per annum and 0.56 per cent per annum respectively from 2.40 per cent per annum and 2.61 per cent per annum respectively in the previous decade. The productivity of pulses during

1995-96 to 2004-05 had a declining (negative) trend of 0.07 per cent, reflecting the absence of any technological breakthrough reaching at farmer's end. Only cotton and maize registered productivity growth rate in excess of 2 per cent during 1995-96 to 2004-05. The healthy performance of cotton and maize, the semi-arid crops grown generally outside the traditional green revolution regions, is due to combined response to the technology, delivery and post-harvest linkages (Planning Commission, December 2006).

Agricultural Growth during 2005-06–2010-11

According to Economic Survey 2008-09,[3] with an average growth of over 4.9 per cent over three years (2005-06 to 2007-08), the agriculture sector (including allied activities) lent credible support to the overall growth in GDP. However, during the first three years of the current Five Year Plan, the agriculture sector (including allied activities) recorded an average growth of 2.03 per cent against the Plan target of 4 per cent per annum. In the first year, 2007-08, of the current Plan the agriculture sector had achieved an impressive growth of 5.8 per cent. However, this high growth could not be maintained in the following two years and agriculture-sector growth fell into the negative zone of - 0.1 per cent in 2008-09, although this was a year of a record 234.47 million tonnes food production. The decline in growth of agricultural GDP was primarily due to the fall in the production of agricultural crops such as oilseeds, cotton, jute and mesta, and sugarcane. In 2009-10, despite experiencing the worst south-west monsoon since 1972 and subsequent significant fall in kharif foodgrain production, the growth marginally recovered to 0.4 per cent primarily due to a good rabi crop. Several advance measures taken by the government to salvage the rabi crop had the desired effect of checking the impact of the drought situation on the rabi crop. Things are looking bright in the current year with a relatively good monsoon and the agriculture-sector is expected to grow at 5.4 per cent as per the 2010-11 advance estimates. The agriculture sector growth in the first four years of the Plan is estimated at 2.87 per cent. In order to achieve the Plan target of average 4 per cent per year, the agriculture sector needs to grow at 8.5 per cent during 2011-12.

Instability in Output

Although the growth rate in food grains output seems to have improved because of the impact of new technology, the growth

3. Government of India, *Economic Survey 2008-09*, ch.7.

performance has by no means been smooth. The instability or the year-to-year variation in food grains output has increased in the post-green revolution period. Even within the post-green revolution period, the instability in the last decade (1978-79 to 1988-89) was higher than in the preceding decade. The rural poor, particularly in the drought-prone areas and in the remote areas of the country, continue to suffer from fluctuations in employment and income and inadequate availability of food grains in years of drought.

However, this increase in instability cannot be attributed to new technology. Rather, the instability arises from the adverse agro-climatic conditions in which the technology is used. The new seed-fertiliser technology has raised the response of output to water. Thus, for a given variability in rainfall or moisture conditions, the instability in output would be greater. However, when the new technology is applied under assured irrigated conditions, the increase in output would be on a stable path. This is exactly what has happened in the case of wheat where the new technology has made the maximum impact. The rise in instability is significant for crops like rice, oilseeds and pulses. This is explained by the increasing application of new seed-fertiliser technology for these crops in rainfed areas and under uncertain irrigation in the recent period. This suggests the need for stabilising consumption through larger procurement of food grains when harvests are good and their liberal release through public distribution system for the vulnerable groups in years of drought.

Regional Disparities and Intra-Personal Disparities

Perhaps the most widely debated issue about green revolution is the growing disparities in income between different regions and classes of farmers. The experience after the mid-seventies covering nearly a decade and half reveals trends which are typical of a diffusion process. These trends are: the spread of green revolution to new areas, the increasing adoption of new technology by the small farmers, the decline in the relative prices of food grains and the rise in real wages in agriculture in the less developed regions where new technology is spreading.

In the early phase of green revolution, large farmers, owing to better access to capital resources, stepped up yields per acre at a faster rate than small farmers. Because of this, in areas experiencing technological change, the inverse relationship between farm size and output per acre began to disappear. In course of time, however, the supply of

institutional credit for the less developed regions and small farmers improved significantly. As a result of this and also because of improved extension services, the use of new seed-fertiliser technology among small farms caught up with that among large farms. And, because of the continued advantage that small farmers have in respect of cropping intensity, the inverse relationship between farm size and output per net operated acre has started reappearing. However, labour input per acre continued to decline sharply with the increase in the size of holding.

Insofar as large farmers have resumed land for self-cultivation from share-croppers because of the profitability of new technology, it has led to lower labour absorption and reduced incomes for erstwhile tenants. However, in quite a few places, cost-sharing on new inputs between landowners and sharecroppers has become popular resulting in the sharing of benefits from new technology by the landowners as well as tenants.

Even in the early phase of green revolution, the emerging disparities between different regions were more conspicuous than the disparities between different classes of farmers within regions experiencing technological change. The uneven regional growth was mainly responsible for low absorption of labour within agriculture. In a large number of states, especially in those regions where there was abundant availability of labour, the growth of output was too slow to generate adequate employment opportunities. In high growth regions, labour was not plentiful and wage rates were high. The sudden rise in the demand for labour in these areas induced mechanisation and labour-saving practices in general. This happened despite the use of migrant labour from the less developed regions for certain operations. The net result was a significant decline in the elasticity of employment with respect to agricultural output for the country as a whole. At the same time, the inter-state disparities in the growth of output and in output per worker continued to increase from the early seventies through the early eighties. However, the inter-state disparities in agricultural wages started declining since the mid-seventies. The decline in disparities in real wages is even more significant. This is because the decline in the relative prices of food grains had a greater impact on the purchasing power of wage earners in low wage areas. For example, the disparities in real wages in agriculture between Punjab, on the one hand and Bihar on the other, started coming down since the mid-seventies. The real wages in Punjab having risen significantly in the early phase of green revolution, virtually stagnated after the mid-seventies whereas the real wages in Bihar started rising. The causes for the decline in inter-state

disparities in real wages are: the out-migration of labour from the less developed regions to the high wage areas; mechanisation of agricultural operations in the developed regions; the decline in the relative prices of food grains; the increase in employment generated in the less developed regions under the poverty alleviation programmes; and the recent pick-up in agricultural growth in these regions. An encouraging consequence of these developments is that the disparity between male- female wage rate has started declining in several states. The use of new technology may have improved the bargaining power of female labour for operations such as transplanting and interculturing on account of the rise in seasonal demand for such labour.

Low income groups, both in the rural and urban areas, would derive greater benefit from the decline in the relative prices of food grains, because they spend a larger proportion of their income on food grains than the upper income groups. Agricultural price policy has been able to ensure that the productivity gains from technological change are shared both by the consumers and producers. However, consumers seem to have benefited relatively more than the producers from the productivity gains, particularly in the case of rice and *jowar*. The demand for wheat has been more favourable than for other cereals. So the decline in the relative price of wheat was only about 25 per cent, while the productivity gains amounted to nearly 45 per cent of output growth.

The indirect contribution of green revolution to equity through food security and the decline in the relative prices of food grains has perhaps been more significant than its direct impact by way of labour absorption in agriculture. Because of slow growth of employment in agriculture, the employment and income generated under poverty alleviation programmes had to be stepped up by using surplus stocks of food grains. From about 20 million man-days of employment generated annually in the mid-sixties, the employment generated under such programmes in the country as a whole amounted to 850 million man-days in 1988-89. These employment programmes together with the income generated under the Integrated Rural Development Programme (IRDP) seem to make up for about half the deficiency in employment generation in agriculture in the post-green revolution period. The relative contribution of these poverty alleviation programmes to employment generation is more significant in the poorer regions where agricultural growth has been below the national average. These programmes have been made possible because of the increased availability of food grains from internal procurement.

New Technology and Environmental Degradation

Pollution of environment due to the intensive use of chemical fertilisers and pesticides has become a major problem in the developed countries. In India, environmental degradation in the rural areas has arisen not so much from the high level of chemical inputs used as from deforestation and extension of cultivation to ecologically fragile areas. Land-saving technological changes by reducing pressure for extension of cultivation and by augmenting biomass, contribute to the conservation of fragile areas and regeneration of forests.

Across different states in India, the extension of area under cultivation and the denudation of forests seem to be high where the progress of yield-increasing technology is slow. In such regions, the levels of agricultural income and wages are low and poverty levels are high. Similarly, the pressure from animals such as goats and sheep on forests and common lands has been increasing in regions where growth in crop production is slow. This is because the rural poor supplement their incomes by rearing these animals.

Major Factors Affecting the Growth Potential

A number of factors are constraining the growth potential of the sector.[4]

i) Lack of Long Term Policy Perspective

On the policy front, there was lack of long-term strategy for agricultural development. One will be surprised to find that only recently the Government has come out with a national agricultural policy. From the very beginning of the planning process in India, especially from the Second Five Year Plan with the sectoral priorities of Mahalanobis model favouring industry, the emphasis has been placed on industry relative to agriculture (Bhide *et al.*, 1998). The policies followed for agricultural development suffers from a number of weaknesses. First, though there was no significant direct taxation of the sector, agricultural sector has suffered from a typical anti-agricultural bias due to the nature of policies followed in other sectors like industry, trade, exchange rate, etc. (Gulati, 1998). Agricultural policies provided little incentives for the farmers, as the agricultural prices were depressed (Indian farmers received lower price than international prices). As there were numerous controls and

4. Jeromi, P.D. (2002). "Is Indian Agriculture Approaching the Limits to Growth", in Raj Kapila and Uma Kapila (eds.), *Economic Developments in India*, Vol. 58. New Delhi: Academic Foundation.

restrictions, the sector was disprotected *vis-a-vis* other sectors of the economy. The restrictions on agricultural exports were believed to be one of the prime reasons for the disprotection of the sector as compared to the industrial sector. Second, agricultural policies gave little emphasis on agricultural exports as a means of stimulating domestic production (Jeromi, 1997). Third, it has excessive price-based focus than non-price factors like water, infrastructure, research and development (R&D), extension services, etc., which are important determinants of agricultural production in India, a fact highlighted more than three decades back by Dantwala (1967) and recently by Pulapare (2000) and Vaidyanathan (2000). These weaknesses of agricultural policies, *inter alia*, affected the faster growth of the sector and in creating a sound infrastructure base for future growth.

ii) Investment in Agriculture and Subsidies

An unfortunate trend over the past two decades has been that expenditure control efforts have led to cutbacks in agricultural investment and extension, but not in subsidies. Budgetary subsidies to agriculture have increased from around 3 per cent of agriculture GDP in 1976-1980 to about 7 per cent in 2001-2003. During the same period, public investment in agriculture declined from over 4 per cent of agriculture GDP to 2 per cent.

The public investment in agriculture in real terms has witnessed steady decline from the Sixth Five Year Plan to the Tenth Plan. However, this trend was reversed in the Tenth Plan (2002-07) and the Eleventh Plan.

The allocation to agriculture and allied sectors in the Centre's Plan was substantially increased from Rs 26,108 crore in the Tenth Plan to Rs 50,924 crore in the Eleventh Plan. However, as percentage of the total Central Plan the share of agriculture and allied sectors continues to be around 2.4 per cent, which increased to around 3 per cent in 2007–08 but again fell to 2.6 per cent in 2008-09, 2.4 per cent in 2009-10 and 2.4 per cent in 2010-11. (MTA Eleventh Plan)

Further, a considerable amount of Plan expenditure on agriculture is not on investment but on subsidies. Simplistic fiscal rules such as protecting Plan expenditures more than non-Plan expenditures add to the problem. For example, although the Plan share in states' total expenditure on agricultural and allied sectors has improved considerably, much of this represents increase in Plan subsidies at the cost of essential staff, particularly in the extension system and the cooperative sector. Even a relatively small percentage reduction in subsidies can finance relatively

large increase in public investment in crucial areas such as soil amelioration, watershed development, groundwater recharge, surface irrigation and other infrastructure, and can also allow substantial expansion in the reach of critical farm support systems.

It is imperative to reduce these subsidies for stepping up public investment in agriculture. However, there is considerable political resistance and, in a democratic polity like India, the process of change towards rational pricing of inputs is bound to be slow. In these days of globalisation and easy flow of information, it is becoming difficult to convince the Indian farmers about the need to reduce such subsidies when their counterparts in the 'market economies' like the United States, European Community and Japan enjoy much higher levels of subsidies. It is not easy to convince the farmers in India that our resources are scarcer and their alternative uses in agriculture are more productive.

Nonetheless, an important policy gain of recent years is the turnaround in public investment in later years of the Tenth Plan, reversing years of decline. Overall capital formation in the sector is now 15 per cent of agricultural GDP, which is the highest in 25 years (Table 12.2). This must have contributed to the recent upturn in growth.

In formulating future policy toward public investment in agriculture and rural development, three areas should get priority: rural roads, electricity (including rural electrification), and major and medium irrigation projects (Panagariya, 2008). Rural roads that feed into major highways connect farmers to the market place, and electricity is the critical input in both agricultural and non-agricultural economic activities. The provision of these two critical amenities can go a long way toward allowing farmers to exploit their private entrepreneurial talents. Major and medium irrigation projects provide a key public input into agriculture.

iii) Lagging Research and Development Efforts

Another important factor limiting the growth potential of the sector is the lack of breakthrough in research and development after the green revolution. Perhaps, it may be one of the reasons for the decline of productivity in the nineties. India compares poorly with the productivity levels in major producing countries.

Since there is hardly any scope for further expansion of area under cultivation, the future production prospects depends largely on the improvements in the yield levels. Here what we need is to break the yield barrier and bridge the gap between the potential and actual yield

through research and development (R&D) efforts. ICAR studies reveals that there is vast unexplored technological potential for improvement in the yield of crops. In this context, Swaminathan (1999) noted that the "low yield phenomena" in India should be considered as a "yield reservoir" and it should be treated as an asset for future development of the sector. Exploiting the "yield reservoir", *inter alia*, require substantial investment and development and deployment of high yielding seed varieties. So far the emphasis has been on the use of HYV seeds, but it loses it vigour with time. Therefore, new varieties need to be developed periodically to expand production possibilities. However, agricultural research established could not come up with improved varieties of seeds, which are suited to different regions of the country, especially in drought-prone areas. Therefore, it is imperative for the country to build up a sound agricultural research system, which is responsive to the changing needs and circumstances.

iv) Technology Generation and Dissemination

With availability of land and water fixed, the goal of 4 per cent growth in agriculture can be achieved only by increasing productivity per unit of these scarce natural resources through effective use of improved technology. The research system has so far focused mainly on breeding varieties that increase the yield potential of individual crops by enabling more intensive use of inputs. But although such research did increase potential yields substantially in the past, it puts less emphasis on the efficient and sustainable use of soil nutrients and water and is no longer leading to adequate outcomes.

Unlike the green revolution technology that began with large farmers in resource-rich areas, community-managed sustainable agriculture focusing on marginal and small farmers in resource-poor dry and drought prone areas needs to be promoted.[5]

v) Rising Soil Degradation and Over-Exploitation of Ground Water

Large-scale soil degradation and over-exploitation of groundwater are other important factors putting limits on growth of the sector. Around 40 per cent of India's total geographical area are officially estimated as degraded (some other estimates put the figure at 50 per cent).

The emergence of rice-wheat crops system in states like Punjab and Haryana, on account of continuous increase in procurement prices, has resulted in over-exploitation of natural resource base. An ICAR study found that soil health is deteriorating in Punjab and Haryana and this is a major cause of decline or stagnation in productivity of cereals, particularly of rice and wheat. The study revealed that the organic carbon content in the soils in Punjab and Haryana has declined to 0.2 per cent in 1995 from 0.5 per cent in the sixties. Soils with low phosphorus content have also increased to 73 per cent from only 3.5 per cent in 1975 in Haryana. Similarly, soils with high potash category have scaled down from 91 per cent in 1975 to 62 per cent in 1995. Further, consequent to the decontrol of prices of phosphorus and potash, there was decline in the application of these fertilisers. This caused nutrient imbalance in the soils. Now farmers have to apply more fertilisers to get the same yield as they were getting with less fertiliser 20-30 years ago. In case of groundwater, the study found that the rapid increase in the number of tubewells during the last three decades in the region has resulted in over-exploitation of groundwater. This decline forces the farmers to lower the pumps further deeper in the wells, which results in the use of irrigation with saline water.

The total irrigation potential in the country has increased from 81.1 million hectares in 1991-92 to 102.08 million hectares up to the end of the Tenth Five Year Plan (2006-07). Of the total potential created, however, only 87.2 million hectares is actually utilised. Even after full utilisation of the irrigation potential, nearly 45 per cent of the net cultivated area will have to depend on rainfall. As the present agricultural development strategy in India is centred mainly on the irrigated areas and the yield levels of crops in many irrigated areas are plateauing, there is a growing realisation that agricultural production cannot be increased beyond a point.

vi) Degradation of Natural Resources

The pressing need to accelerate agriculture growth should not be at the cost of sustainability of our natural resource base, which is starkly limited. This is compounded by degradation of soil and over-exploitation of groundwater. Deforestation has affected both soils and water. Action on these environmental fronts cannot wait, especially in the face of a possibly looming adverse climate change due to global warming.

Rural Distress in Post-Reform India

A recent nationwide survey (NSS 59th Round, Report 498, 2005) brings out the grave agrarian situation in terms of farmer indebtedness.